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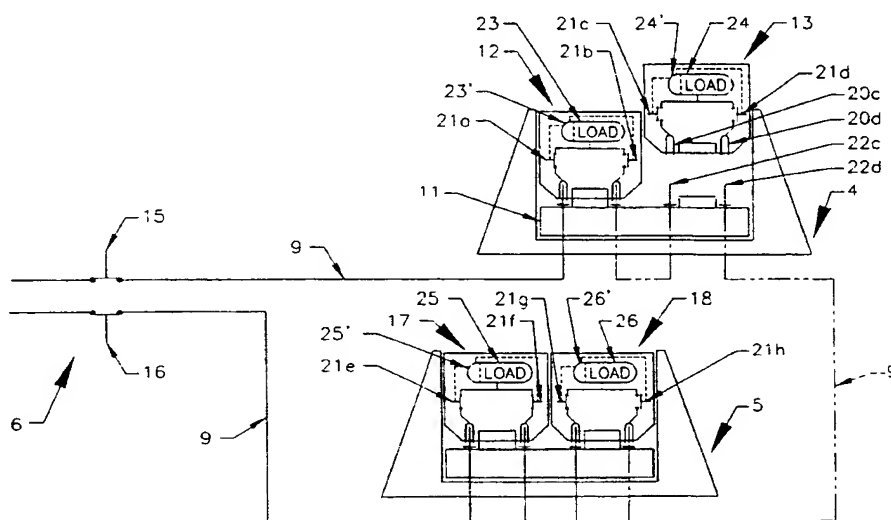
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(54) Title: **ELECTRICAL POWER DISTRIBUTION SUITABLE FOR A SUBSTANTIALLY UNDERWATER SYSTEM**



(57) Abstract: A substantially underwater system comprises a plurality of retrievable substantially autonomous subsea modules (12, 13, 17, 18) and switchgear (15, 16, 21a...h). A host facility (6) and the modules are connected in series so as to form a circuit, the host facility providing power to all of the modules. Operation of the switchgear electrically isolates a module or a plurality of serially adjacent modules so that the module or modules can be removed without cutting off the power supply to any of the remaining modules of the system. Module based parts of the switchgear (21a...h) only or a combination of module based parts (21a...h) and host facility based parts (15, 16) of the switchgear are actuated depending on which module or modules are isolated and removed.

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ELECTRICAL POWER DISTRIBUTION SUITABLE FOR  
A SUBSTANTIALLY UNDERWATER SYSTEM

The present invention relates to electrical power distribution suitable for  
5 a substantially underwater system used in an underwater oil/gas field.

Conventional oil/gas fields have a plurality of wells linked to a host  
facility which receives the oil/gas via flow lines. If the underwater oil/gas field  
includes underwater processing units between the wells and the host facility,  
it would be useful to be able to reconfigure or replace an underwater  
10 processing unit without having to power down the other underwater  
processing units in the field and thereby significantly reduce production from  
the field.

Presently, any underwater processing units which require power/  
controlling rely on at least one expensive and complex multiple conduit  
15 hydraulic line to connect each part to a host facility on/above the sea surface  
or onshore.

It is an object of the present invention to provide an improved method  
and system which alleviates/solves problems associated with power  
distribution to a system, particularly one which is substantially underwater.

20 According to one aspect of the present invention there is provided a  
method of electrical power distribution or control signal distribution suitable for  
a substantially underwater system, comprising the steps of:

providing a plurality of retrievable substantially autonomous modules,  
module isolating means and a host facility, the host facility and the modules  
25 being connected in series so as to form a circuit, the host facility providing  
power or control signals to all of the modules;

isolating at least one module by operation of the module isolating  
means; and

removing the isolated at least one module without cutting off the  
30 supply of power or control signals to any of the remaining modules of the

system.

There is preferably a plurality of series connected sub-systems, each including a plurality of said modules connected in series, the step of isolating the at least one retrievable module by module isolating means not cutting off  
5 the supply of power or control signals to the remaining modules.

Each module may have a module based part of the module isolating means and the host facility may have a host facility based part of the module isolating means and wherein the step of isolating the at least one retrievable module may involve the operation of two of said parts of said  
10 module isolating means. Each module based part of the module isolating means may include two switches in series relationship, each switch being on opposite sides of connection means to an electrical load of the module, and the host facility based part of the module isolating means may include a switch in each of the two electrical connections between the host facility and  
15 the modules and wherein the step of isolating at least one module may involve the operation of two of said switches.

It is preferable for one module or a plurality of serially adjacent modules to constitute a removable part of the system to be isolated and removed. The step of isolating the removable part of the system may involve operation of  
20 serially adjacent parts of the module isolating means on opposite sides of the removable part. The parts of the module isolating means operated may both be module based parts thereof when the serially adjacent parts on opposite sides of the removable part are modules. Alternatively, the parts of the module isolating means operated may comprise a module based part thereof  
25 and a host facility based part thereof when one of the serially adjacent parts on one side of the removable part is a module and that on the opposite side comprises part of the host facility.

Each module desirably includes a first portion of a disconnectable electrical power connector means and may be engaged in a location having a  
30 complementary second portion of the electrical power connector means and

wherein removal of the or each module may involve removing it from its associated location thereby disengaging the complementary portions of the electrical power connector means. The electrical power connector means may be wet mateable in order that the connector means can mate underwater.

5 Preferably, one portion of the electrical power connector means is a plug and the other portion is a socket. At least one module may include a transformer to which the first portion of the electrical power connector means is connected whereby high voltage power received by the module is lowered to an acceptable level for the module to effectively operate.

10 Each removed module may be replaced with a replacement module and the module isolating means may be operated to restore series power distribution or control signal distribution throughout the system. With such replacement it is possible for the remaining modules to continue to operate.

At least one different module may be subsequently removed from the  
15 system using the method described above.

The method may be for electrical power distribution and control signal distribution.

Preferably, the module isolating means comprises switchgear for electrically isolating at least one module.

20 The system is preferably substantially underwater. The host facility may not be underwater. The sub-systems are desirably on a seabed.

The system may include control means for substantially controlling operation of the module in order that normal operation of the module is controlled by the control means making the module substantially autonomous.

25 Thus, the control means may provide control to the many parts of the module that need power/controlling. Desirably, the or each module includes the control means. The control means may be at least substantially an electrical control means or the control means may comprise a completely electrical control means. Such an arrangement obviates the requirement for many  
30 hydraulic lines from the host facility to various parts of the module that need

controlling. The host facility is desirably in communication with the control means. This may be via the electrical power connector means. Alternatively, the host facility may be in communication with the control means via control connector means separate from the electrical power connector means. Thus, the controllable parts of the modules are not separately connected by individual lines to the host facility. The control connector means may be wet mateable.

The power distribution system permits the removal of one or more modules without powering down the system and in which the electrical switchgear is not present in apparatus into which the module is inserted, i.e. apparatus which will normally remain on, say, a seabed. Should any problem occur with the switchgear of a given module for example, electrical isolation of that module can be achieved by remote operation of the switchgear in the adjacent modules or adjacent module and host facility.

According to another aspect of the present invention there is provided a system comprising a plurality of retrievable substantially autonomous modules, module isolating means, and a host facility, the host facility and the modules being connected in series so as to form a circuit, the host facility being arranged to provide power or control signals to all of the modules, the series connections and the module isolating means being arranged such that isolating at least one module so that it or they can be removed does not cut off the supply of power or control signals to any of the remaining modules of the system.

An embodiment of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:-

Figure 1 is a schematic diagram of a subsea field comprising a substantially underwater system according to one embodiment of the invention;

Figure 2 is an elevational view of a modular seabed sub-system of the substantially underwater system;

Figures 3 and 4 are schematic diagrams of a subsea field comprising the modular seabed sub-systems of Figure 2;

Figure 5 is a schematic circuit diagram of the subsea field; and

Figures 6 to 9 are schematic diagrams of a subsea field showing various modules being removed from modular seabed sub-systems using the method according to the invention.

Referring to Figures 1 and 2 of the accompanying drawings, a subsea field 1 includes wells 2 for removing a fluid mixture comprising water and oil/gas from reservoirs beneath the seabed. The wells 2 are connected by underwater flow lines 3, such as rigid and/or flexible pipelines, to modular subsea or seabed sub-systems 4,5 of a substantially underwater system where the oil and/or gas may be extracted from the fluid mixture and the oil/gas flows under well pressure or is pumped to a host facility 6 via flow lines 7,8, the flow lines 7,8 connecting the modular seabed sub-systems 4,5 in series to the host facility 6. A plurality of wells may be connected to a template before being connected to a modular seabed sub-system. The host facility may be, for example, onshore or on a fixed or a floating rig. The host facility 6 has an integrated power and control line 9 connecting the modular seabed sub-systems 4,5 in series to form a circuit, the host facility 6 providing the power and control to these sub-systems 4,5.

Each modular seabed sub-system 4,5 comprises a support frame 10 which is essentially of a tubular framework construction and is secured to the seabed. Inside each frame 10 is a docking unit or location 11 which is connected to flowlines by flowline tie-in and installation tools which are operated by remote operating vehicles (ROVs) or directly from a ship. Two retrievable substantially autonomous modules 12,13 (of which only one module 12 can be seen in Fig. 2 as it blocks the view of module 13 behind it) are installed in the frame 10. The modules 12,13 are connected to the docking unit 11 by multi-ported valve isolation connectors 14 which are described in GB-A-2261271. The retrievable modules are designed to include

a variety of equipment, such as separators for separating gas and liquid comprising oil and water from the fluid mixture received via flow lines 3, the separated gas and liquid being pumped to the host facility via the further flow lines 7,8.

5 Referring to Figure 3, a field 1 comprising a substantially underwater system is shown having a host facility 6 and first and second modular seabed sub-systems 4,5 connected in series by an integrated power/control line 9 to form a circuit. The power/control line 9 thus carries signal information as well as power. Any flow lines have been omitted for clarity. The circuit is  
10 breakable at the host facility 6 by means of switchgears 15,16 which each isolate one of the two ends of the power/control line 9 from a power and control supply at the host facility 6. Each seabed sub-system 4,5 has two retrievable substantially autonomous subsea modules 12,13;17,18 with the first seabed sub-system 4 having the modules 12,13 installed therein. Each  
15 module has two electric power distribution switchgears 21a...h in series relationship, each switchgear being on opposite sides of a connection 27 to an electrical/hydraulic load 23,24,25,26 via a transformer (not shown). Each switchgear is also connected to a power/control socket 20a...h and each socket has an associated power/control plug 22a...h which is connected to  
20 the docking unit 11. The power/control sockets 20a...h and plugs 22a...h are high voltage, high power subsea wet mateable electrical connectors like those described in EP 0428515, for example, in which the connector is mated in insulating liquid which is then replaced with gas at near atmospheric pressure.

Each retrievable module 12,13,17,18 has a control chamber and power  
25 chamber (not shown). The control chamber houses control electronics 23',24',25',26' which form part of the load 23,24,25,26, and the power chamber houses the power switchgear 21a...h. The control electronics 23',24',25',26' controls the normal running of the module and is in communication with the host facility via the integrated power/control line 9  
30 from where it may, for example, be reprogrammed or be instructed to shut

down the module and open or close the switchgear 21a...h. The control chamber and power chamber are constructed as pressure vessels and have cables from the sockets 20a...h of the connectors outside the chambers connecting to the control electronics 23',24',25',26' and switchgear 21a...h in their chambers. To reduce high voltage input from a socket, the socket may be connected to the control electronics via a transformer (not shown).

Figure 3 shows each docking unit 11 having four power/control plugs 22a...d,22e...h. For the first seabed sub-system 4 the first plug 22a is connected to the host facility 6, the second plug 22b is connected to the third plug 22c and the fourth plug 22d is connected to a plug 22h in the second seabed sub-system 5. The modules 12,13 being installed on docking unit 11 are respectively adapted to provide the connections between the first and second plugs 22a,22b and the third and fourth plugs 22c,22d. Thus, when module 12 is installed, plug 22a will be connected to plug 22b in series via socket 20a, switchgear 21a,21b and socket 20b and when module 13 is installed, plug 22c will be connected to plug 22d in series via socket 20c, switchgear 21c,21d and socket 20d. The second seabed sub-system 5 is similar to the first seabed sub-system 4 with modules 17,18 being shown already installed on the docking unit 11. Thus, module 17 causes plug 22e to be connected to plug 22f in series via socket 20e, switchgear 21e,21f and socket 20f and module 18 causes plug 22g to be connected to plug 22h in series via socket 20g, switchgear 21g,21h and socket 20h. Hence, there is a circuit connecting the seabed sub-systems 4,5 to the host facility 6.

Figure 4 shows all the modules 12,13,17,18 installed. When the field 1 is commissioned, the host facility switchgear 15,16 is activated to connect the circuit to the power supply. The power flows from the supply via the closed host facility switchgear 15 to load 23 via closed switchgear 21a and also from the closed host facility switchgear 16 to load 25 via closed switchgear 21e. The power to load 23 then flows to load 24 via closed switchgear 21b,21c and the power to load 25 flows to load 26 via closed



switchgear 21f,21g. Load 24 is connected to load 26 via closed switchgear 21d,21h thus completing the circuit so that power can flow in either or both directions from the host facility in the manner of a "ring main".

The power/control line 9 comprises three-phase power supply lines 5 9a,9b,9c illustrated in the simplified circuit diagram shown in Figure 5. The power supply line 9a forms a series connection from the switchgear 15 to the switchgear 16 through the modules 12,13,17,18. The power supply line 9b also forms a series connection from the switchgear 15 to the switchgear 16 through the modules 12,13,17,18 as does the power supply line 9c. Each 10 load 23,24,25,26 is connected across the power supply lines 9a,9b,9c as shown. Each host facility switchgear 15,16 and switchgear 21a...h effects the switching of all three power supply lines 9a,9b,9c.

To retrieve a module from one of the seabed sub-systems, that module needs to be electrically isolated. Figures 6 and 7 shows module 13 being 15 isolated and retrieved from the first seabed sub-system 4. Switchgear 21h in module 18 and switchgear 21b in module 12, which are serially adjacent and are on opposite sides of the module 13, are opened thus isolating module 13. This is effected by sending an apparatus control signal down the power/control line 9 from the host facility 6. Coding of the signal enables the 20 control electronics 23',24',25',26' of each module to determine which signals relate to which module. Each switchgear 21b,21h to be opened is accordingly actuated by its associated control electronics 23',26'. The remaining modules 12,17,18 are all still electrically connected to the host facility 6 and so can continue to operate and module 13 is then retrieved as shown in Figure 7. 25 Once retrieved, module 13 may be inspected/adjusted before being lowered back to and installed in the sub-system 4 or a separate replacement module may be lowered and installed. The sockets 20c,20d (see Fig. 7) of the lowered module dock and mate with the plugs 22c,22d of the docking unit 11. Switchgear 21h in module 18 and switchgear 21b in module 12 are 30 closed thus connecting the lowered module to the host facility 6 and hence

restoring series power distribution throughout the substantially underwater system.

Figures 8 and 9 shows module 12 being retrieved from the first modular seabed sub-system 4. Module 12 is serially adjacent to the host facility 6.  
5 Host facility switchgear 15 and switchgear 21c in module 13, which are serially adjacent to and are on opposite sides of the module 12, are opened thus isolating module 12. The remaining modules 13,17,18 are all still connected to the host facility 6 and so can continue to operate and module 12 is then retrieved as shown in Figure 9. Module 12 may then be replaced in a  
10 similar manner to that described above for module 13.

It is possible to isolate and retrieve a plurality of serially adjacent modules. For example, to retrieve both modules 12 and 13, host facility switchgear 15 and switchgear 21h in module 18, which are serially adjacent  
15 to and are on opposite sides of the modules 12 and 13, are opened thus isolating modules 12,13. The two remaining modules 17,18 are still connected to the host facility 6 and so can continue to operate and modules 12,13 are then retrieved. To retrieve, say, both modules 13 and 18, switchgear 21b,21f are opened, isolating module 13 and 18.

The modular seabed sub-systems are all electric, although hydraulics  
20 could be used if so desired for selected functions. Electrical systems can operate over greater distances / deeper levels, transmit emergency signals instantaneously, such as to shut down a part of a seabed sub-system, and are cheaper to manufacture and maintain.

If the modular seabed sub-systems are not operating at a long distance  
25 from the host facility then high voltage may not be required and consequently the modules may not require transformers.

Whilst a particular embodiment has been described, it will be understood that various modifications may be made without departing from the scope of the invention. For example, the sub-systems may be land based  
30 and not underwater. Any suitable number of modular sub-systems may be

used in a field. Each sub-system may be designed to hold any suitable number of retrievable modules. The integrated power/control line may be replaced by a supply umbilical carrying power and control lines or by separate power and control lines, the control line being connected to the module by a disconnectable, wet mateable connector. The plugs may be located on other parts of the sub-system and not just the docking unit. Although the sub-systems have been described as extracting oil/gas they may not necessarily process the fluid mixture from the reservoir and may, for example, simply commingle or pump the fluid mixture.

CLAIMS:

1. A method of electrical power distribution or control signal distribution suitable for a substantially underwater system, comprising the steps of:
  - 5 providing a plurality of retrievable substantially autonomous modules (12,13,17,18), module isolating means (15,16,21a...h) and a host facility (6), the host facility and the modules being connected in series so as to form a circuit, the host facility providing power or control signals to all of the modules;
  - 10 isolating at least one module by operation of the module isolating means (15,16,21a...h); and
  - removing the isolated at least one module without cutting off the supply of power or control signals to any of the remaining modules of the system.
- 15 2. A method as claimed in claim 1, including a plurality of series connected sub-systems (4,5), each including a plurality of said modules (12,13,17,18) connected in series, the step of isolating the at least one retrievable module by module isolating means (15,16,21a...h) not cutting off  
20 the supply of power or control signals to the remaining modules.
3. A method as claimed in claim 1 or 2, each module having a module based part (21a...h) of the module isolating means and the host facility having a host facility based part (15,16) of the module isolating means and wherein  
25 the step of isolating the at least one retrievable module involves the operation of two of said parts of said module isolating means.
4. A method as claimed in claim 3, wherein each module based part (21a...h) of the module isolating means includes two switches in series  
30 relationship, each switch being on opposite sides of connection means (27) to

an electrical load (23,24,25,26) of the module (12,13,17,18), and the host facility based part (15,16) of the module isolating means includes a switch in each of the two electrical connections (9) between the host facility (6) and the modules and wherein the step of isolating at least one module involves the  
5 operation of two of said switches.

5. A method as claimed in claim 3 or 4, wherein one module (12,13,17,18) or a plurality of serially adjacent modules constituting a removable part of the system are isolated and removed.  
10

6. A method as claimed in claim 5, wherein the step of isolating the removable part of the system involves operation of serially adjacent parts of the module isolating means (15,16,21a...h) on opposite sides of the removable part.  
15

7. A method as claimed in claim 6, wherein the parts of the module isolating means operated are both module based parts (21b,21h) thereof.

8. A method as claimed in claim 6, wherein the parts of the module  
20 isolating means operated comprise a module based part (21c) thereof and a host facility based part (15) thereof.

9. A method as claimed in any preceding claim, wherein each module includes a first portion (20a...h) of a disconnectable electrical power connector means and engages a location (11) having a complementary second portion (22a...h) of the electrical power connector means and wherein removal of the  
25 or each module involves removing it from its associated location thereby disengaging the complementary portions of the electrical power connector means.

30

10. A method as claimed in any preceding claim, including the further steps of replacing the or each removed module with a replacement module and operating the module isolating means (15,16,21a...h)) to restore series power distribution or control signal distribution throughout the system.

5

11. A method as claimed in claim 10, including the further steps of removing at least one different module from the system using the method according to claim 1.

10 12. A method as claimed in any preceding claim, wherein the method is for electrical power distribution and control signal distribution.

13. A method as claimed in any preceding claim, wherein the system (1) is substantially underwater.

15

14. A method as claimed in claim 2 or any claims dependent thereon, wherein the sub-systems (4,5) are on a seabed.

15. A system comprising a plurality of retrievable substantially autonomous modules (12,13,17,18), module isolating means (15,16,21a...h), and a host facility (6), the host facility and the modules being connected in series so as to form a circuit, the host facility being arranged to provide power or control signals to all of the modules, the series connections and the module isolating means (15,16,21a...h) being arranged such that isolating at least one module (12,13) so that it or they can be removed does not cut off the supply of power or control signals to any of the remaining modules of the system.

25

16. A system as claimed in claim 15, including a plurality of series connected sub-systems (4,5), each including a plurality of said modules (12,13,17,18) connected in series.

30

17. A system as claimed in claim 15 or 16, wherein each module has a module based part (21a...h) of the module isolating means and the host facility has a host facility based part (15,16) of the module isolating means.
- 5
18. A system as claimed in claim 17, wherein each module based part (21a...h) of the module isolating means includes two switches in series relationship, each switch being on opposite sides of connection means (27) to an electrical load (23,24,25,26) of the module (12,13,17,18) and the host
- 10 facility based part of the module isolating means includes a switch (15,16) in each of the two electrical connections (9) between the host facility (6) and the modules, at least one module being adapted to being isolated by involving the operation of two of said switches.
- 15
19. A system as claimed in claim 17 or 18, wherein one module (12,13,17,18) or a plurality of serially adjacent modules constitute a removable part of the system to be isolated and removed.
- 20
20. A system as claimed in claim 19, wherein serially adjacent parts of the module isolating means (15,16,21a...h) on opposite sides of the removable part are adapted to isolate the removable part of the system.
21. A system as claimed in claim 20, wherein the parts of the module isolating means are both module based parts (21b,21h) thereof.
- 25
22. A system as claimed in claim 20, wherein the parts of the module isolating means operated comprise a module based part (21c) thereof and a host facility based part (15) thereof.
- 30
23. A system as claimed in any one of claims 15 to 22, wherein each

module includes a first portion (20a...h) of a disconnectable electrical power connector means and the system including a location (11) having a complementary second portion (22a...h) of the electrical power connector means for the first portion to engage so that the removal of the or each  
5 module involves removing it from its associated location thereby disengaging the complementary portions of the electrical power connector means.

24. A system as claimed in any one of claims 15 to 23, wherein the module isolating means (15,16,21a...h) is adapted to restore series power distribution  
10 or control signal distribution throughout the system when the or each removed module has been replaced with a replacement module.

25. A system as claimed in any one of claims 15 to 24, wherein the host facility is arranged to provide power and control signals to all of the modules,  
15 the series connections and the module isolating means (15,16,21a...h) being arranged such that isolating at least one module (12,13) so that it or they can be removed does not cut off the supply of power and control signals to any of the remaining modules of the system.

20 26. A system as claimed in any one of claims 15 to 25, wherein the module isolating means (15,16,21a...h) comprises switchgear for electrically isolating at least one module (12,13,17,18).

27. A system as claimed in any one of claims 15 to 26, including control  
25 means (23',24',25',26') for substantially controlling operation of the module (12,13,17,18).

28. A system as claimed in claim 27, wherein the or each module  
30 (12,13,17,18) includes the control means (23',24',25',26').



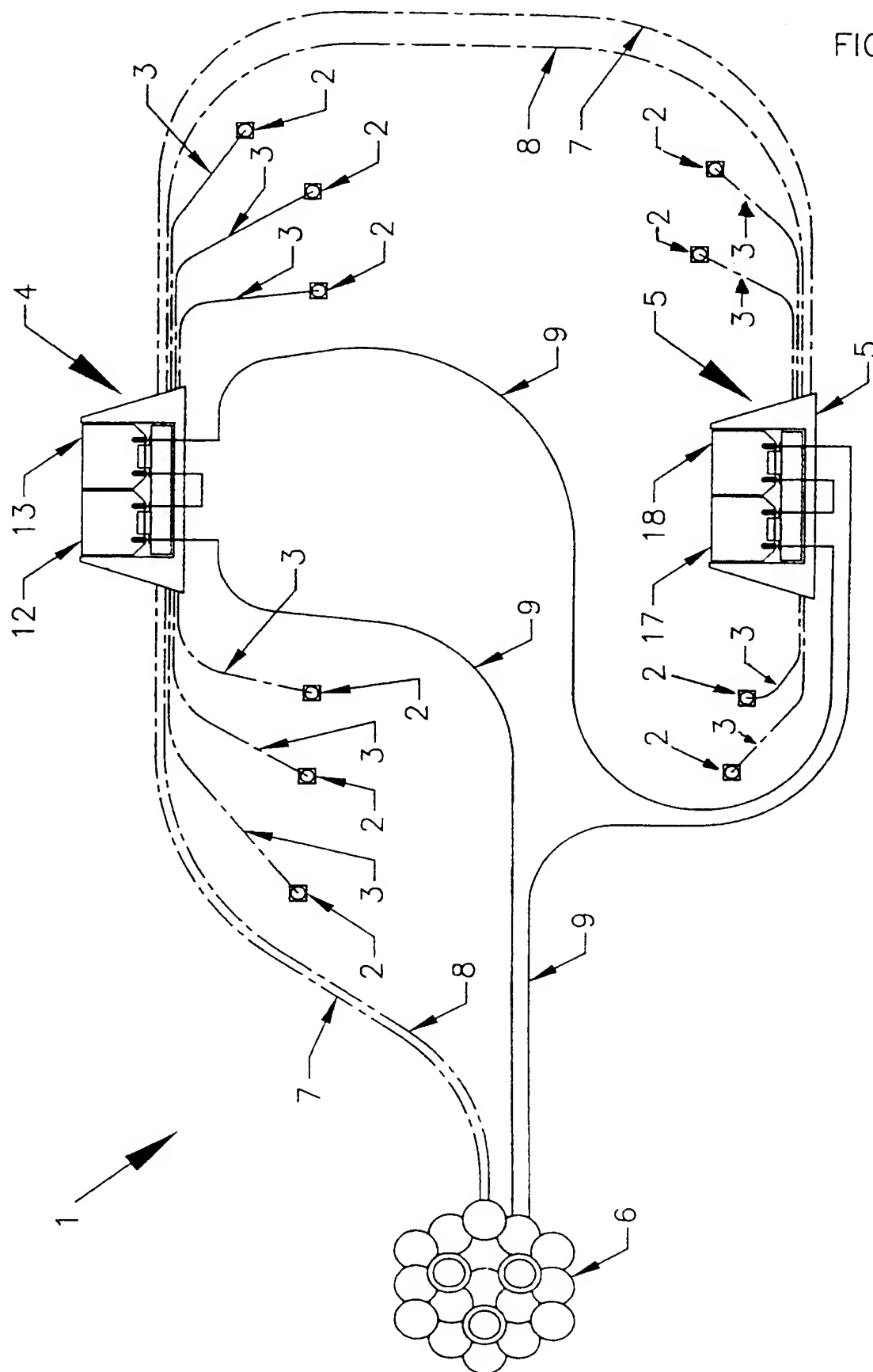
29. A system as claimed in claim 27 or 28, wherein the control means (23',24',25',26') is at least substantially an electrical control means or the control means comprises a completely electrical control means.
- 5 30. A system as claimed in claims 27, 28 or 29, wherein the host facility (6) is in communication with the control means (23',24',25',26').
31. A system as claimed in claims 23 and 28, wherein the host facility (6) is in communication with the control means (23',24',25',26') via the electrical  
10 power connector means (20a...h,22a...h).
32. A system as claimed in claims 23 and 30, wherein the host facility (6) is in communication with the control means (23',24',25',26') via control  
15 connector means separate from the electrical power connector means (20a...h,22a...h).
33. A system as claimed in claim 32, wherein the control connector means is wet mateable.
- 20 34. A system as claimed in claim 23 or any claims dependent thereon, wherein the electrical power connector means (20a...h,22a...h) is wet mateable.
35. A system as claimed in claim 23 or any claims dependent thereon,  
25 wherein one portion of the electrical power connector means is a plug (22a...h) and the other portion is a socket (20a...h).
36. A system as claimed in any one of claims 15 to 35, wherein the system is substantially underwater.

37. A system as claimed in claim 36, wherein the host facility (6) is not underwater.

38. A system as claimed in claim 16 or any claims dependent thereon,  
5 wherein the sub-systems (4,5) are on a seabed.

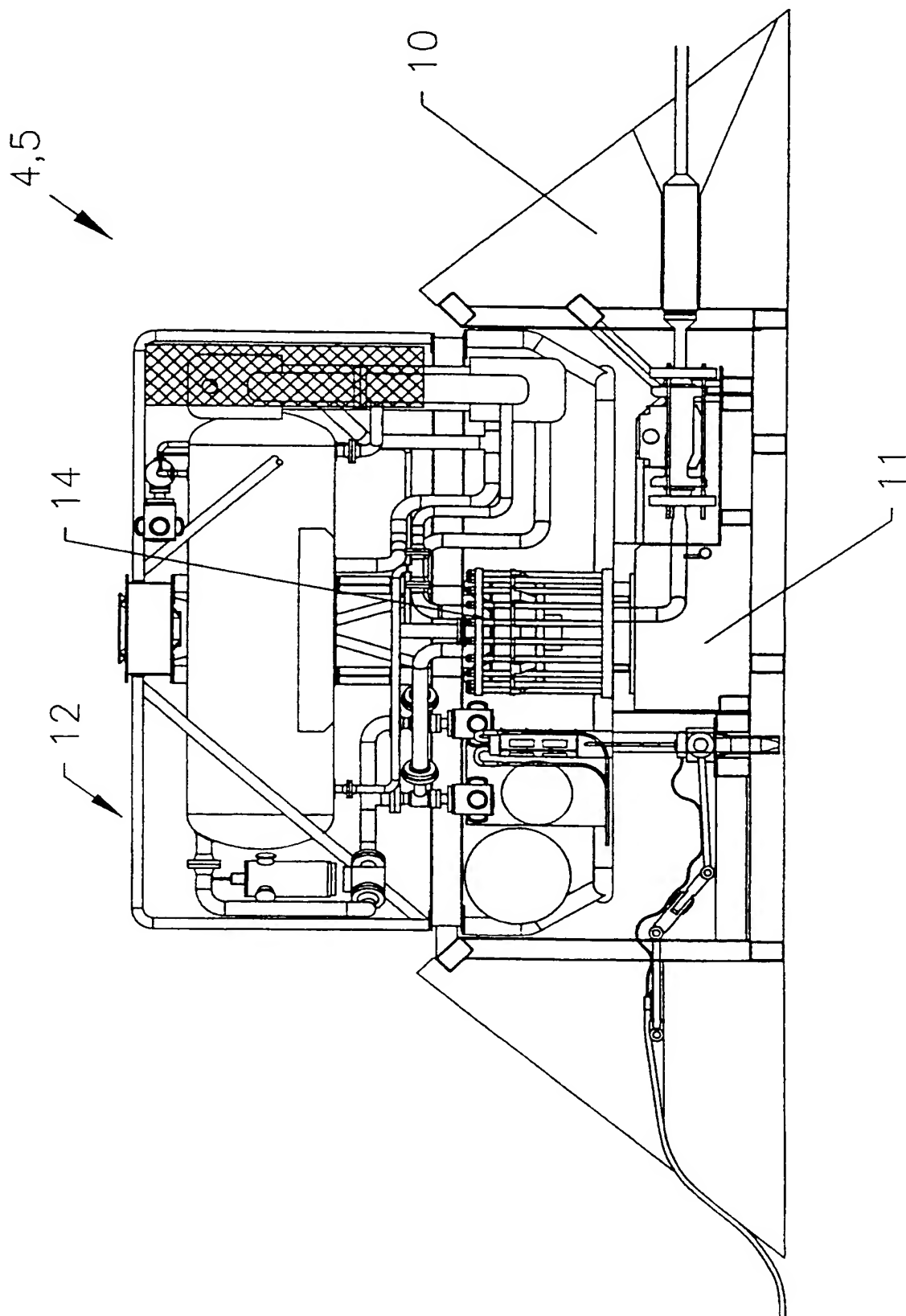
39. A system as claimed in claim 23 or any claims dependent thereon,  
wherein at least one module (12,13,17,18) includes a transformer to which  
the first portion (20a...h) of the electrical power connector means is  
10 connected.

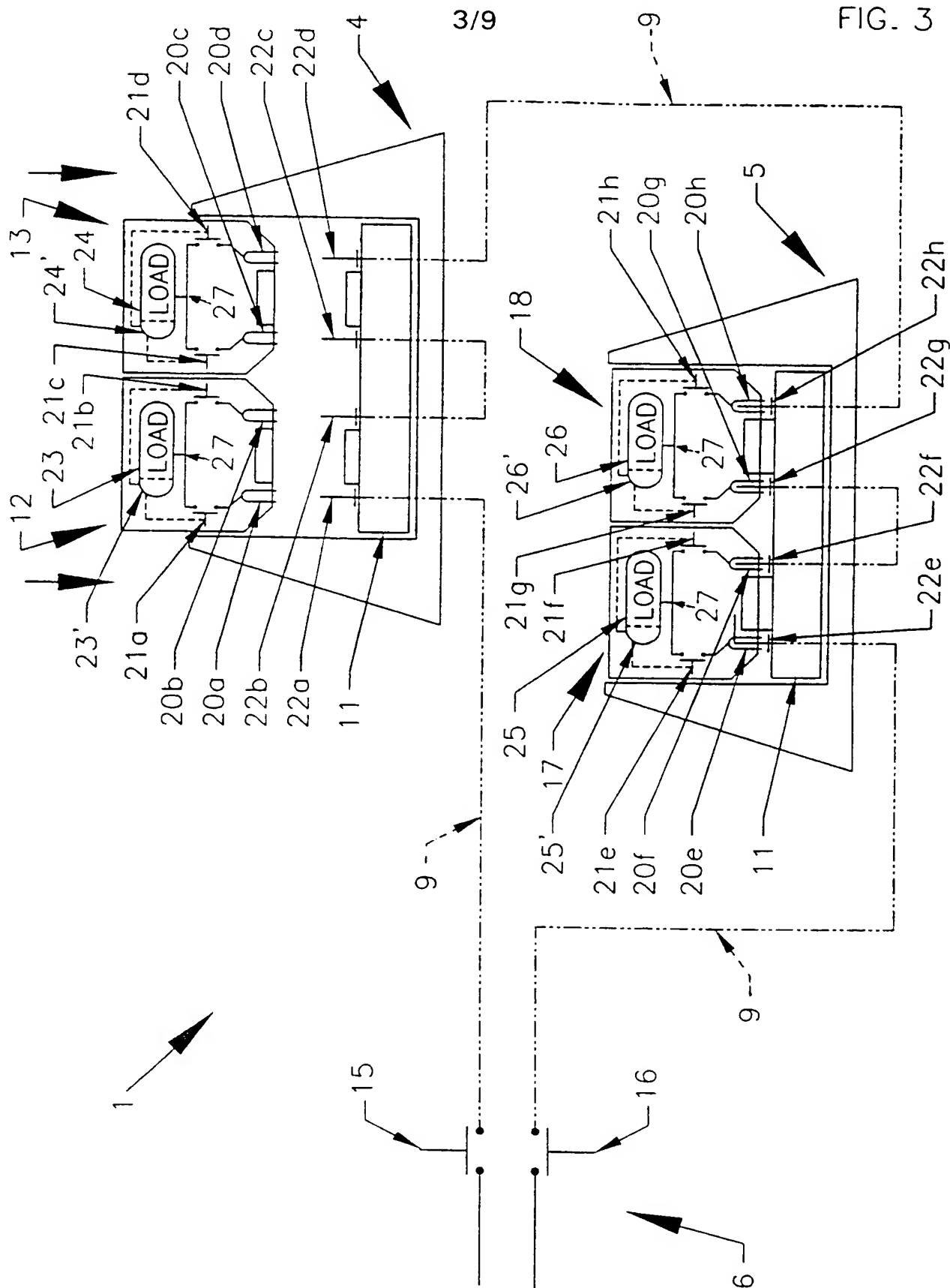
FIG. 1



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FIG. 2





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FIG. 4

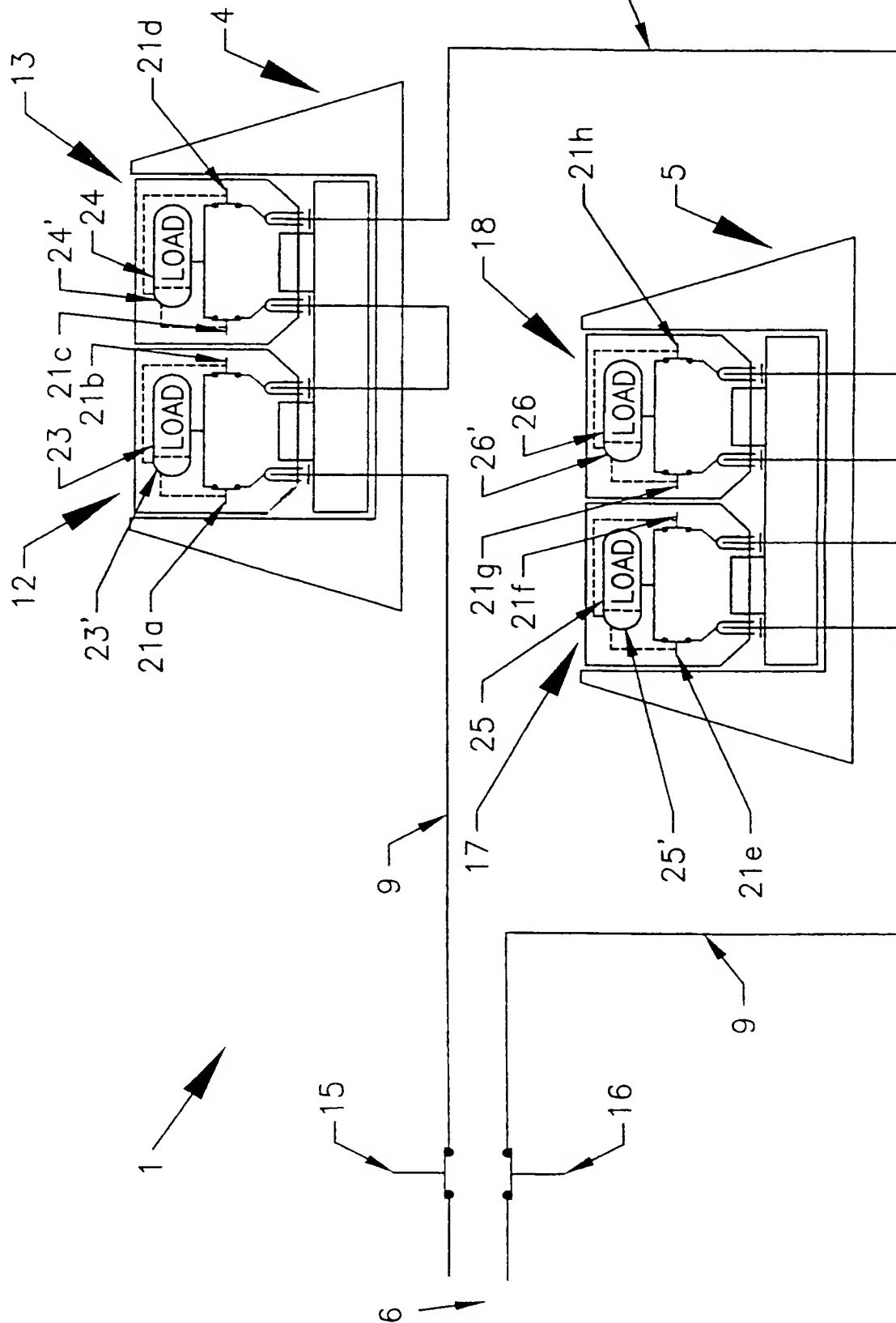
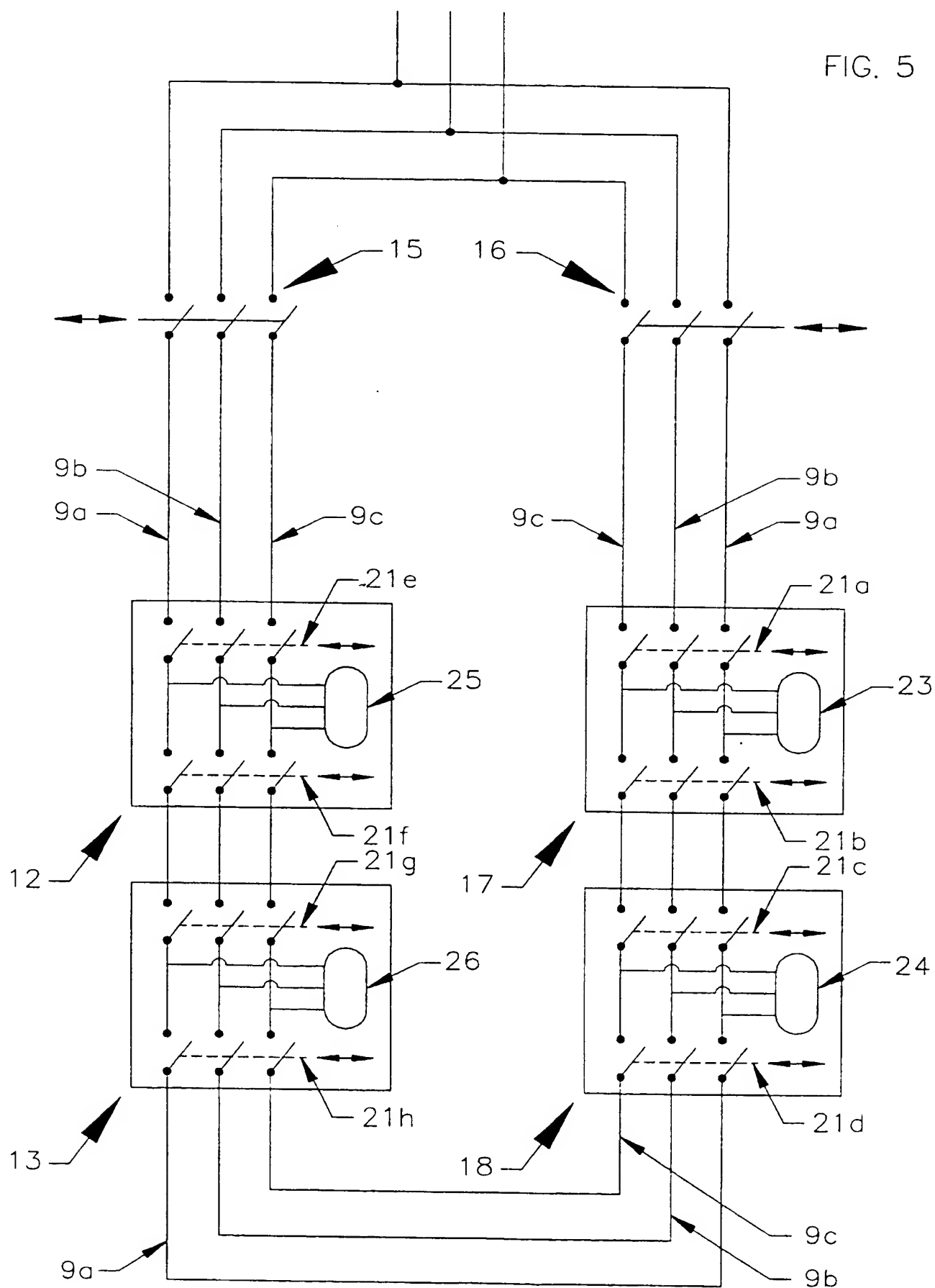
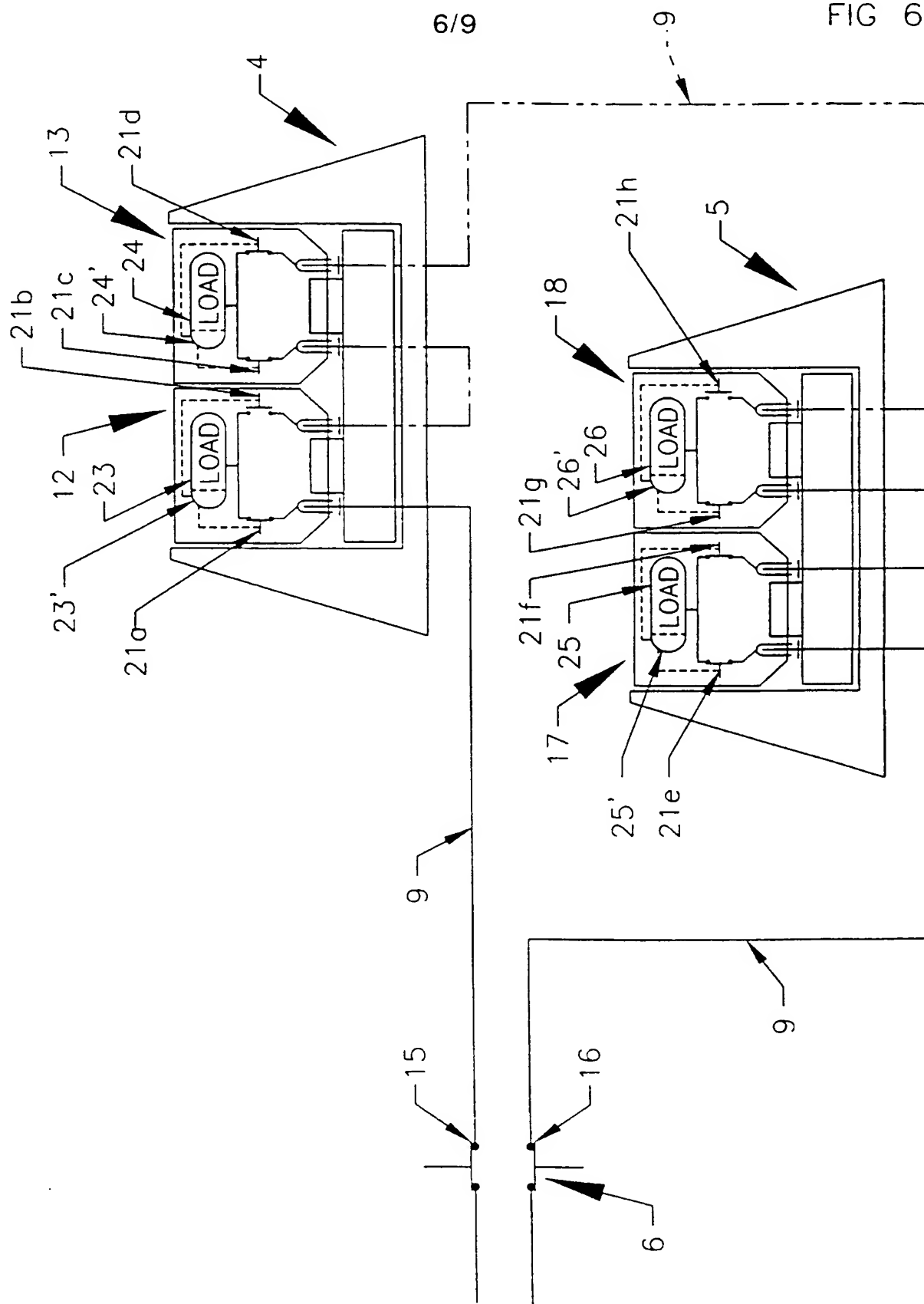


FIG. 5

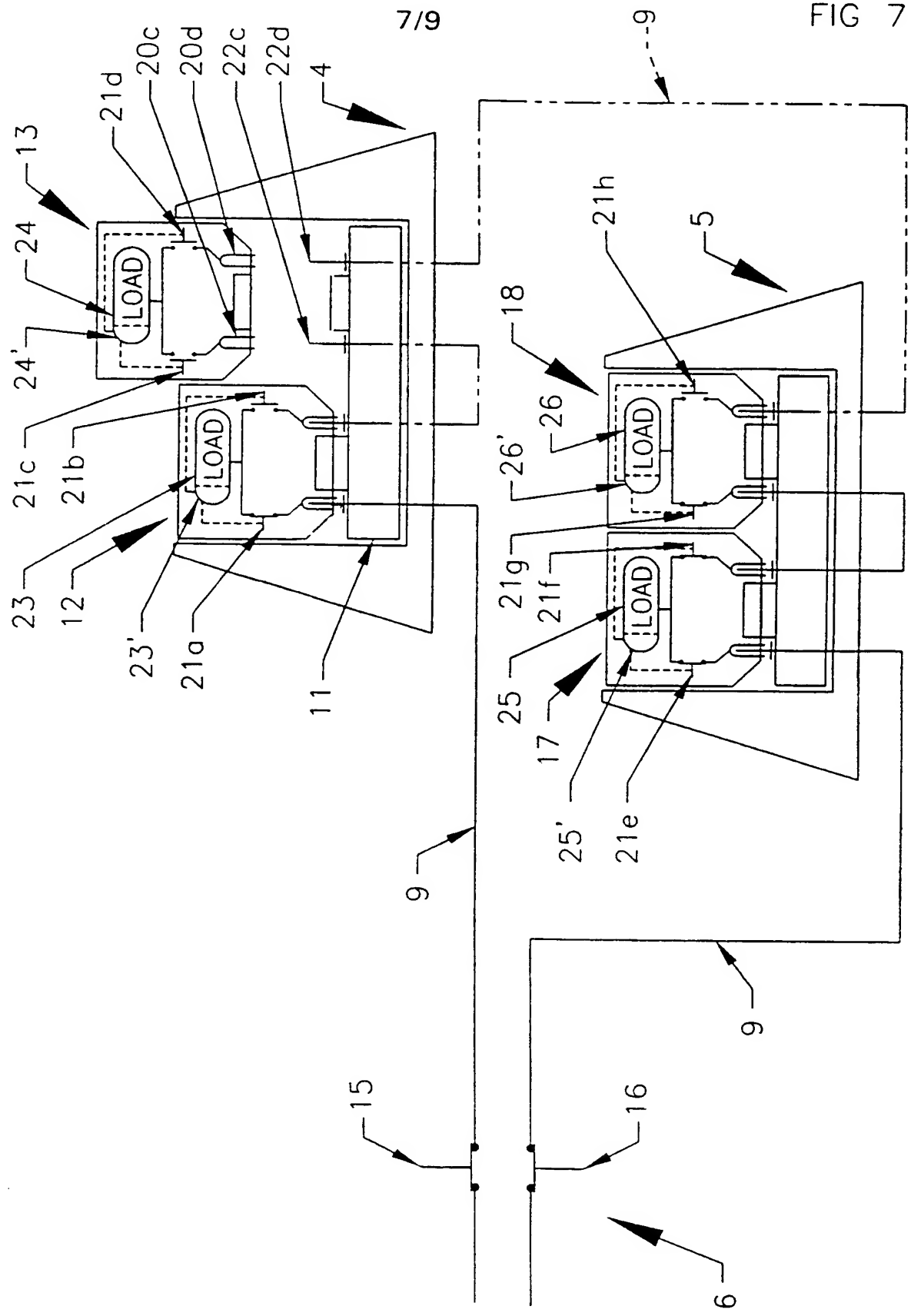


6/9

FIG 6







8/9

FIG 8

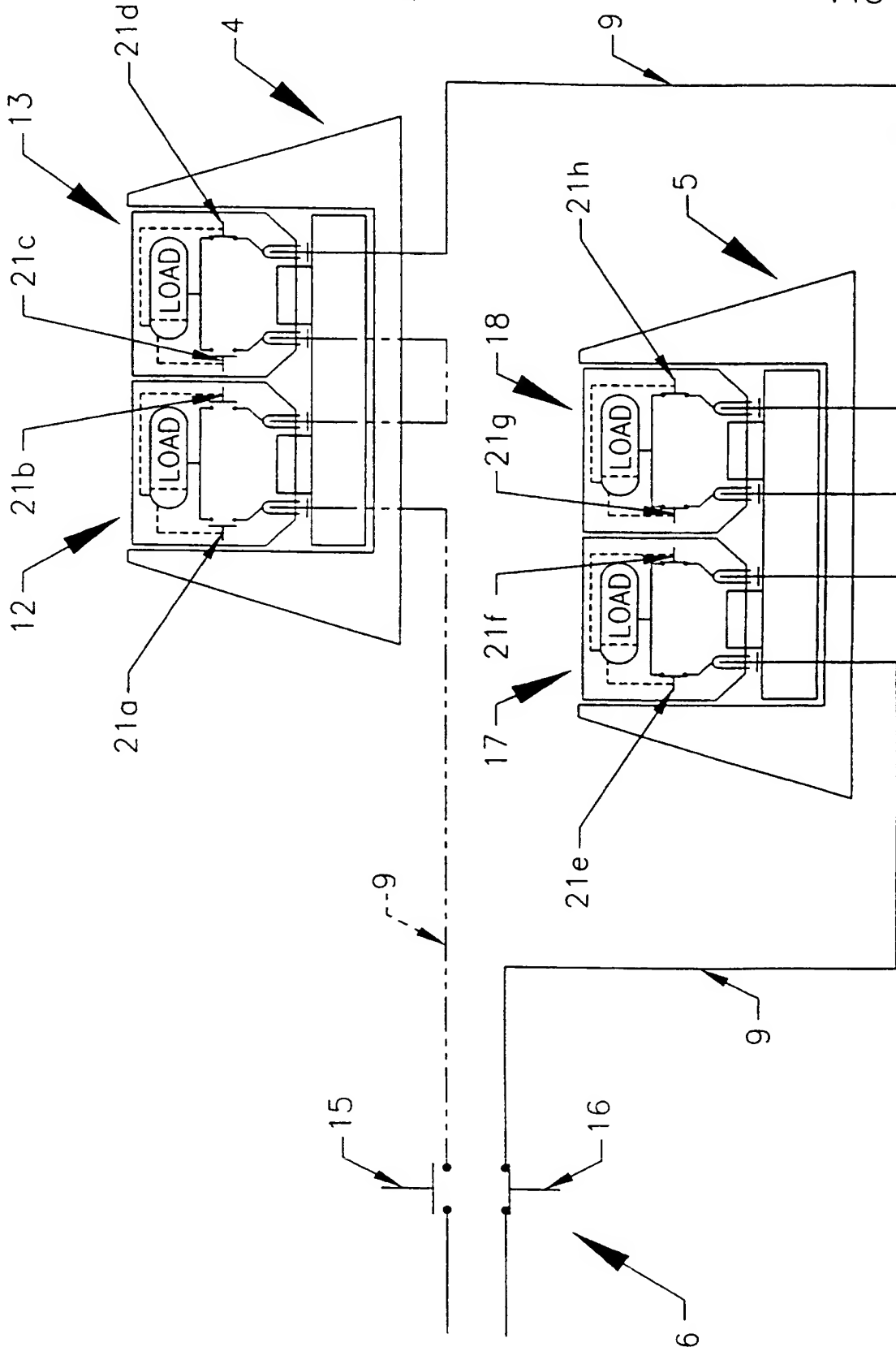
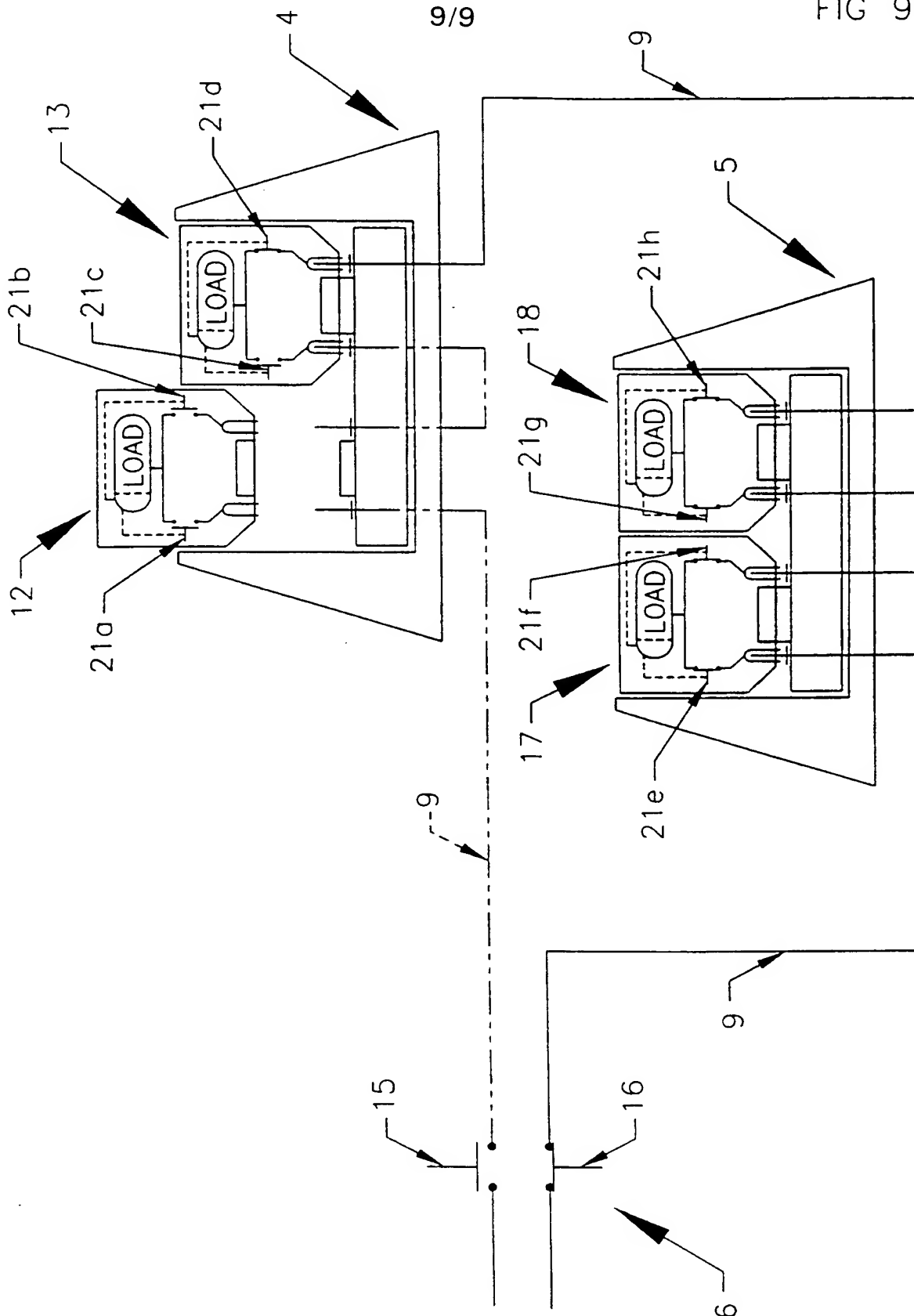


FIG 9



# PATENT COOPERATION TREATY

## PCT

### INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference DJ/34767	<b>FOR FURTHER ACTION</b>		See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/GB00/03220	International filing date (day/month/year) 18/08/2000	Priority date (day/month/year) 10/09/1999	
International Patent Classification (IPC) or national classification and IPC H02J4/00			
Applicant ALPHA THAMES LTD. et al.			

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.



2. This REPORT consists of a total of 6 sheets, including this cover sheet.

- ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand  06/04/2001	Date of completion of this report  08.08.2001
Name and mailing address of the international preliminary examining authority:   European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer  Drysedale, N  Telephone No. +49 89 2399 2435  

# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB00/03220

## I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

**Description, pages:**

1-10 as originally filed

**Claims, No.:**

1-39 as originally filed

**Drawings, sheets:**

1/9-9/9 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB00/03220

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

## V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

### 1. Statement

Novelty (N)	Yes: Claims 1-39
	No: Claims
Inventive step (IS)	Yes: Claims 1-39
	No: Claims
Industrial applicability (IA)	Yes: Claims 1-39
	No: Claims

2. Citations and explanations  
**see separate sheet**

## VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:  
**see separate sheet**

## VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:  
**see separate sheet**

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

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International application No. PCT/GB00/03220

**V. Reasoned statement**

**2. Citations and explanations**

**1. Reference is made to the following documents:**

D1: WO 97 14206 A (INVETECH OPERATIONS PTY LTD ;LOH PIT KIN (MY))

17 April 1997 (1997-04-17)

D2: EP-A-0 752 668 (SUN MICROSYSTEMS INC) 8 January 1997 (1997-01-08)

D3: US 3865142 A.

The document D3 was not cited in the international search report. A copy of the document is appended hereto.

2. Document D3 represents the closest available prior art. It discloses a method and system of electrical power distribution and control signal distribution suitable for a substantially underwater system. A plurality of substantially autonomous modules (14-1 - 14-5) (Fig. 4) is provided adjacent a plurality of respective underwater wells. Each module is connected to a host facility (12a) via an intermediate station (400). The host facility (12a) provides 115V DC power and control signals via cables (18a, 18b1 - 18b5) to all of the modules (col. 7, line 65 to col. 8, line 3; col. 10, line 52 to col. 11, line 37). The host facility is connected directly to each module by respective cables (18b1 - 18b5).

Although D3 envisages the possibility of a failure in a module (col. 7, lines 65-67) it contains no teaching concerning isolation and removal of a module, with or without first cutting off power or control signals to any of the remaining modules.

3. The subject-matter of present independent claims 1 and 15 is thus distinguished from the teaching of D3 in that:
- the host facility and the modules are connected in series so as to form a circuit; and
  - module isolating means are provided, so that at least one module can be isolated and removed without cutting off power or control signals to any of the remaining modules.

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

---

International application No. PCT/GB00/03220

4. Document D1 concerns a modular power supply, particularly for use as an uninterruptable power supply (UPS). The number of modules can be increased or decreased to match the power demand of the load, and modules may be connected or disconnected without switching off the power. However, the modules of D1 are connected **in parallel** (see abstract). There is no suggestion in D1 that the power supply disclosed therein would be suitable for underwater applications. Thus, the teaching of D1 is not novelty-destroying for the subject-matter of the present application. Moreover, a skilled person would not consult D1 for assistance in solving the problem underlying the present application, viz. that of removing and/or replacing a module **served by** a central power supply without cutting off power or control signals to the other modules, nor would the combination of the teaching of D1 with that of D3 lead to the subject-matter of present claims 1 and 15.
5. Document D2 addresses problems which are specific to computers with plug-in modules that are powered from the main computer. The modules are not connected in series so as to form a circuit. There is no suggestion that the disclosed system would be suitable for use under water. D2 thus has no teaching relevant to the present application. The same is true for the other documents cited in the international search report.
6. The subject-matter of claims 1 and 15 is therefore new and inventive in the light of the available prior art (Art. 33(2) & (3) PCT).
7. The dependent claims define advantageous embodiments of the method of claim 1 and the system of claim 15. Their subject-matter is therefore also novel and inventive (Art. 33(2) & (3) PCT).
8. Industrial applicability (Article 33(4) PCT) is obvious for all claims.

**VII. Certain defects**

1. Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the document D3 is not mentioned in the description, nor is this docu-



**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

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International application No. PCT/GB00/03220

ment identified therein.

**VIII. Certain observations**

1. Claims 1 and 15 are not clear (Art. 6 PCT), in that they do not include all the technical features essential to define the invention.

Both claims state that **at least one** module can be removed without cutting off the supply of power or control signals to any of the remaining modules of the system. However, it emerges from the description that, if a plurality of modules is to be removed, then these modules must be **adjacent** in the circuit. This is because the invention relies on the fact that power and/or control signals can reach modules by travelling either clockwise or anticlockwise around the circuit. Removing a module, however, does create a break in the loop. Thus, if two non-adjacent modules were to be removed, the module or modules located between the removed modules would be cut off from the power and/or control signal supply.

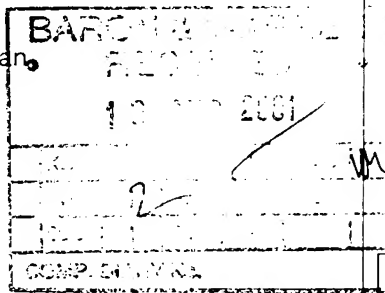
Claims 1 and 15 should, therefore, have been amended to make this clear.

# PATENT COOPERATION TREATY

From the  
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

JOHNSTONE, Douglas Ian  
BARON & WARREN  
18 South End  
Kensington  
LONDON W8 5BU  
GRANDE BRETAGNE



## PCT

NOTIFICATION OF TRANSMITTAL OF  
THE INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT  
(PCT Rule 71.1)

Date of mailing  
(day/month/year) 08.08.2001

Applicant's or agent's file reference  
DJ/34767

### IMPORTANT NOTIFICATION

International application No.  
PCT/GB00/03220

International filing date (day/month/year)  
18/08/2000

Priority date (day/month/year)  
10/09/1999

Applicant  
ALPHA THAMES LTD. et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

#### 4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA,



European Patent Office  
D-80298 Munich  
Tel. +49 89 2399 - 0 Tx: 523656 epmu d  
Fax: +49 89 2399 - 4465

Authorized officer

Looijen, H

Tel. +49 89 2399-2613



## PATENT COOPERATION TREATY

PCT

## NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Commissioner  
 US Department of Commerce  
 United States Patent and Trademark  
 Office, PCT  
 2011 South Clark Place Room  
 CP2/5C24  
 Arlington, VA 22202  
 ETATS-UNIS D'AMERIQUE  
 in its capacity as elected Office

<b>Date of mailing</b> (day/month/year) 29 May 2001 (29.05.01)	<b>Applicant's or agent's file reference</b> DJ/MR/34767
<b>International application No.</b> PCT/GB00/03220	<b>Priority date</b> (day/month/year) 10 September 1999 (10.09.99)
<b>International filing date</b> (day/month/year) 18 August 2000 (18.08.00)	
<b>Applicant</b> APPLEFORD, David, Eric et al	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:

06 April 2001 (06.04.01)

☐ in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was  
☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

<p>The International Bureau of WIPO          34, chemin des Colombettes          1211 Geneva 20, Switzerland</p> <p>Facsimile No.: (41-22) 740.14.35</p>	<p>Authorized officer          Zakaria EL KHODARY</p> <p>Telephone No.: (41-22) 338.83.38</p>
--	---

# INTERNATIONAL SEARCH REPORT

International Application No.  
PCT/GB 00/03220

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 H02J4/00

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
IPC 7 H02J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 97 14206 A (INVETECH OPERATIONS PTY LTD ;LOH PIT KIN (MY)) 17 April 1997 (1997-04-17) abstract; figure	1, 15
X	EP 0 752 668 A (SUN MICROSYSTEMS INC) 8 January 1997 (1997-01-08) abstract; figure	1, 15
A	GB 2 261 271 A (ALPHA THAMES ENG) 12 May 1993 (1993-05-12) cited in the application	
	-/--	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

\* Special categories of cited documents:

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y\* document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- \*Z\* document member of the same patent family

Date of the actual completion of the international search

13 December 2000

Date of mailing of the international search report

20/12/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Lampe, S

# INTERNATIONAL SEARCH REPORT

Interi Application No

PCT/GB 00/03220

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>HUNTER P L ET AL: "FAULT TOLERANT, HOT-PLUGGABLE POWER SYSTEM DESIGN" PROCEEDINGS OF THE ANNUAL APPLIED POWER ELECTRONICS CONFERENCE AND EXPOSITION (APEC),US,NEW YORK, IEEE, vol. CONF. 9, 13 February 1994 (1994-02-13), pages 815-822, XP000467397 -----</p>	

# PATENT COOPERATION TREATY

# PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>DJ/MR/34767</b>	<b>FOR FURTHER ACTION</b> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. <b>PCT/GB 00/ 03220</b>	International filing date ( <i>day/month/year</i> ) <b>18/08/2000</b>	(Earliest) Priority Date ( <i>day/month/year</i> ) <b>10/09/1999</b>
Applicant  <b>ALPHA THAMES LTD. et al.</b>		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

**1. Basis of the report**

a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

☒ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

7 \_\_\_\_\_

☐ None of the figures.

# INTERNATIONAL SEARCH REPORT

Information on patent family members

Interim Publication No

PCT/GB 00/03220

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO 9714206	A	17-04-1997	AU 7121696 A	30-04-1997
			BR 9611095 A	28-12-1999
			CA 2234449 A	17-04-1997
			CN 1202281 A	16-12-1998
			EP 0855097 A	29-07-1998
			JP 11515158 T	21-12-1999
			US 6121695 A	19-09-2000
EP 0752668	A	08-01-1997	US 5644731 A	01-07-1997
			AU 717666 B	30-03-2000
			AU 5627696 A	23-01-1997
			CA 2180093 A	08-01-1997
			JP 9222940 A	26-08-1997
GB 2261271	A	12-05-1993	BR 9206734 A	21-11-1995
			EP 0611411 A	24-08-1994
			WO 9310327 A	27-05-1993
			NO 941737 A	10-05-1994
			US 5494110 A	27-02-1996